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New record of the viviparous lizard *Zootoca vivipara* (Jacquin, 1787) in Hungary

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Abstract

The lowland populations of the viviparous lizard *Zootoca vivipara* in the Carpathian Basin occur in cold, marshy relict habitats. In one of the largest wetlands in Hungary, Kis-Balaton, in 2016 its presence was confirmed by catching an individual with a small mammal live-trap. This new record is significant, since the nearest known sites of occurrence are at great distance and it is situated between the lowland viviparous populations of the north-northeast and the oviparous populations of the south (in Croatia).

Key Words

Balaton-felvidéki National Park, glacial relict, Lacertidae, oviparous, wetland

The viviparous lizard *Zootoca vivipara* (Jacquin, 1787) is a terrestrial reptile species with the largest distribution area on Earth, which occupies almost the entire northern Palearctic region (Dely and Böhme 1984). It is a cold-adapted species, with the most northerly distribution of any lizard, nearing the Arctic Circle, and occurrence at altitudes of up to 2400 m a.s.l. (Schmidtler and Böhme 2011; Rodríguez-Díaz and Braña 2012). In the northern part of its range, it occurs mainly in the lowlands, while in the south it is more frequent in mountains, with the exception of the Carpathian Basin (Böhme 1997; Puky et al. 2004). Isolated viviparous lizard populations were found in the north-western part of Hungary near Lake Fertő (Neusiedler), and in the Hanság area (Dely 1978; Puky et al. 2004). There are sporadic occurrences in the central part of Hungary, between the Danube and the Tisza Rivers, between Ócsa and Kiskőrös settlements (e.g. Dely 1978; Puky et al 2004, 2005; Velekei 2015). In the eastern part of Hungary, lowland areas bordering Ukraine and Romania (Satu Mare, Bereg plains, southern and eastern part of the Nyírség, and Bihari plain) there is a larger, continuous population of viviparous lizards with individuals appearing in the parks of larger cities such as Vásárosnamény, Fehérgyarmat or Mátészalka (Dely 1978; Puky et al. 2004, 2005; Somlai 2020). This species occurs sporadically in the western and central parts of Hungary, but it is more frequent in the eastern part, with a population density estimated at 10–50 and 150–250 individuals/hectare, respectively (Puky et al. 2004; Somlai 2020). In the large-scale habitats of Bereg, Szatmár and Nyírség, the stable populations are characterized by 500–1500 individuals/hectare, but their number may decrease significantly due to persistent droughts (Somlai 2020).

In the Transdanubian region of Hungary, its occurrence data were previously known only in the north-western part of the country. One adult male individual of viviparous lizard was caught accidentally by the live-trap during the monitoring of the glacial relict Pannonian root vole *Alexandromys oeconomus mehelyi* in the area of Kis-Balaton called Halász-rét (46°42'04.88"N, 17°15'15.48"E, XM77 according to 10×10 km UTM grid), on September 1, 2016. Five photos were taken and the intact animal was released at the same site (Fig. 1). No measuring of the captured lizard or genetic sampling was performed, as we did not have the

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Figure 1. The viviparous lizard (adult, male) caught with a small mammal live trap at Kis-Balaton, on September 1, 2016 (photos by: Boldizsár Szűcs).

necessary tools and the appropriate research permits. However using the holding hand (in the picture) as a reference for calibrating the measurement, we estimated snout-vent length (47 mm) and minimum tail length (62 mm). Kis-Balaton, part of the Balaton-felvidéki National Park, is one of the largest near-natural wetlands in the Carpathian Basin, with an area of 14,745 hectares (Horváth et al. 2011, 2012). The sampling location was situated about 200 m west of the river Zala. The landscape pattern includes deeper areas with reed-beds and homogeneous patches of sedges, while drier areas are covered by goldenrod (*Solidago gigantea*). In the spring and autumn periods the most important abiotic constraint factor is water level fluctuation, as evoked by the combined effect of precipitation and water management (Horváth et al. 2011). Despite extensive herpetological research in the Lake Balaton and Kis-Balaton areas, the occurrence of viviparous lizard has not been known so far (Tóth 2015), suggesting that it occurs rarely in this area. We hypothesize that in Kis-Balaton, even in the vicinity of Lake Fertő and in Hanság, the viviparous lizard is present in similar places as the Pannonian root vole, which is also a glacial relict (Varga 2018). This rodent occurs in several habitat patches in Kis-Balaton and in the marshy areas along the southern shore of Lake Balaton (Gubányi 2014), so it is conceivable that in the future the viviparous lizard can also be detected in other locations. The new occurrence of the viviparous lizard is in line with the findings of Korsós (2007), which suggest that following the glacial period, due to the increasingly warmer and drier climate, plant communities with a cool microclimate, e.g. bogs, have survived in few places in Carpathian Basin, which helped the survival of species adapted to a colder climate, including also the

viviparous lizard. The proximity of the mountains and good water supply may have provided favourable conditions for viviparous lizards. These populations may have survived together with these habitats (Horreo et al. 2018). Thus, the Carpathian Basin may have not only been a refuge, but even a target of repeated colonization processes during climate change (Horreo et al. 2018).

The new record of the viviparous lizard from the Southern Transdanubia region is significant, because the nearest known sites of occurrence are at great distance from Kis-Balaton (for the recent distribution see: Hungarian National Amphibian and Reptile Mapping Program 2021): Hanság is 100 km north, the habitats between the Danube and the Tisza are 160 km northeast, while in Croatia, the known sites are located about 180 km to the south-east. The occurrence of viviparous lizards with oviparous reproduction mode, has been shown in the north-eastern part of Croatia in several sites in lowlands (80–120 m a.s.l.), in flooded grasslands and alluvial forests (Jelić and Bogdanović 2011; Jelić et al. 2012; Baškiera and Jelić 2013). Nevertheless, the other known lowland populations within the Carpathian Basin, are all viviparous. It should be noted that the other known sites in North Croatia closest to Kis-Balaton are inhabited by small isolated mountain populations, e.g. in Macelj Mts. (Lauš 2016) and Mts. Papuk (Barišić and Bogdanović 2011; Jelić et al. 2012).

In addition to the topographical barriers, this population of the viviparous lizard living in Kis-Balaton is separated from the neighbouring populations by agricultural areas and river barriers (e.g. Rába, Sió, Danube, Drava). In the wetlands of Kis-Balaton and the southern shore of Lake Balaton, the occurrence, reproduction, chromosome and molecular analysis of the viviparous lizard is needed as soon as possible. This knowledge can contribute to a better understanding of the phylogeographic pattern of the species and to the conservation of its population.

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